UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SO-AL

REPLY TO: 4050 Research Programs

November 16, 1981
(RWU 2203)

SUBJECT: Study Plan, FS-SO-2203-1.46, entitled "A survey of the mycangial fungi in endemic and epidemic southern pine beetle populations" by J. Robert Bridges

TO:

TO: S. J. Barras, AD-W

Attached for your information is a copy of subject study plan and study plan summary.

Bettie J. Mallard

for PETER L. LORIO, JR.
Project Leader
Forest Insect Research

Enclosure

PLLorio,Jr./bjm

4500
FS-SO-2203-1.46
(Problem 2)

September 1981
Study Plan Summary
J. Robert Bridges - Alexandria, La.

A SURVEY OF THE MYCANGIAL FUNGI IN ENDEMIC AND EPIDEMIC SOUTHERN PINE BEETLE POPULATIONS

Various populations of the southern pine beetle, Dendroctonus frontalis Zimm. (SPB), will be sampled to determine the presence or absence of the two mycangial fungi--Ceratocystis minor var. barrasii and an unidentified Basidiomycete. The frequency of occurrence of the two fungi will be compared between expanding (epidemic) and non-expanding (endemic) populations. Comparisons will also be made among populations from various geographic areas and among populations collected at various times of the year.

The primary purpose of the study is to determine whether a difference in the occurrence of the mycangial fungi exists between endemic and epidemic populations. If so, this information could help explain why endemic populations sometimes proliferate into outbreaks.

4500
FS-SO-2203-1.46
(Problem 2)

STUDY PLAN

A SURVEY OF THE MYCANGIAL FUNGI IN ENDEMIC AND EPIDEMIC SOUTHERN PINE BEETLE POPULATIONS

Prepared by:

J. Robert Bridges — Date: 11/16/81
Research Entomologist

Approved by:

Peter L. Lorio, Jr. — Date: 11/16/81
Project Leader
RWU 2203

INTRODUCTION

The southern pine beetle, Dendroctonus frontalis Zimm. (SPB), has two symbiotic fungi that are propagated and transported in the female's mycangium. These fungi are obligate symbionts because their removal results in poor development of the beetle (Barras 1973). One of these fungi (SJB 133) is Ceratocystis minor (Hedgcock) Hunt var. barrasii Taylor (Barras and Taylor 1973). The other (SJB 122) is an unidentified Basidiomycete. These fungi can be observed microscopically in the mycangium of emergent SPB (Barras and Perry 1972). The two fungi are seldom intermixed in the mycangium. Either a single species occupies the whole mycangium, or the two species occur on opposite sides of the mycangium (Barras and Taylor 1973). Barras and Perry (1972) most often observed SJB 122 as the only fungus present in the mycangium.

Because individual beetles may have only one fungus in the mycangium, the possibility exists that various populations of beetles have differing frequencies of occurence of these two fungi. If so, the frequency of occurrence of these fungi could be an indicator of the success of a beetle population. Therefore, knowledge of these fungi could be an important factor in understanding why outbreaks of SPB occur.

OBJECTIVES

The objectives of this study are to determine the frequency of occurrence of the two SPB mycangial fungi:

a) in endemic vs epidemic SPB populations,

b) in SPB populations from various geographic locations, and

c) from season to season.

METHODS AND MATERIALS

Detection of fungi--Emerging SPB will be collected, weighed, and examined immediately or kept frozen until examination. The prothoracic mycangium will be removed, and the two sides of the mycangium will be mounted separately on a microscope slide in lactophenol. Based on the size and shape of spores observed the species of fungus will be determined.

Collection of beetles--Trees naturally infested with SPB will be felled, and two sample bolts will be removed (one from two meters and one from five meters high). The bolts will be placed in rearing cans, and all the SPB will be collected and counted as they emerge. One hundred females from each bolt will be weighed and examined to determine which of the mycangial fungi are present. After all the brood have emerged from each bolt, the bolt will be examined to determine the number of attacks. From this, the ratio of increase will be calculated (Thatcher and Pickard 1964).

Selection of SPB infestations--"Endemic" will be used in this study to describe populations from small, non-expanding infestations (spots). "Epidemic" refers to beetles from expanding infestations.

For comparisons among seasons, three trees from endemic spots will be sampled each season from Louisiana or Mississippi.

To compare between endemic and epidemic populations, three trees (replications) from each type of infestation will be sampled. This part of the study is planned for Louisiana. Because of the absence of epidemic spots in Louisiana now, endemic populations will be sampled during the first year. Epidemic spots will be sampled the following year as they become available. An alternative approach will be to collect data for epidemic populations from another geographic area if epidemic infestations cannot be located in Louisiana.

For geographic comparisons, beetles from endemic spots from other states will be collected, frozen, and shipped to Louisiana for examination. These beetles will be compared to beetles collected from endemic spots during the same season in Louisiana or Mississippi.

ANALYSIS OF THE DATA

The responses to be measured will be the following:

1) No. of beetles (of 200 examined) that have only fungus 133,
2) No. of beetles that have only fungus 122,
3) No. of beetles that have both fungi,
4) No. of beetles that have neither fungus,
5) Weight of each beetle, and
6) Ratio of increase for beetle population within each tree.

Important questions to be answered include:

1) Does one fungus occur more frequently than the other, and if so, does the higher frequency of occurrence of that fungus occur in epidemic or endemic populations?
2) Do endemic populations of beetles have more individuals that have neither of the fungi?
3) Do epidemic populations have more individuals with both fungi?
4) Does the frequency of occurrence of the mycangial fungi vary with the season?
5) Does the frequency of occurrence of the mycangial fungi vary among discrete SPB populations such as from one geographic area to another?
6) Is the size of individual beetles related to the presence or absence of the mycangial fungi?
7) Is the presence or absence of the two mycangial fungi in a population of beetles related to the ratio of increase of the brood?

Epidemic vs endemic populations--An analysis of variance (ANOVA) will be used to compare endemic and epidemic populations for each response.

Source of variation	df
Population	1
Tree in population	4
Bolt in trees	6
Total	11

A multiple linear regression analysis will be used to determine the relationship between the ratio of increase of each beetle brood and the frequency of occurrence of the mycangial fungi.

Seasonal effects--For comparison among seasons an ANOVA will be run for each response as follows:

Source of variation	df
Season	3
Trees in season	8
Bolts in trees	12
Total	23

Geographical effects--To compare among populations from various locations, only the first four responses (see above) will be measured. Beetle collections from various trees from other states will be pooled before shipment to Louisiana. Therefore, data for these states will not be replicated. To analyze these data a chi-square test of independence will be used. The contingency table will be as follows:

Location	No. beetles with: Only Fungus 133	Only Fungus 122	Both	Neither	Total
North Carolina					
South Carolina					
Georgia					
Arkansas					
Louisiana					
Mississippi					

Beetle weight--To analyze the relationship of beetle size and the presence or absence of mycangial fungi the following analysis will be done:

ANOVA to compare the mean weight of beetles among the following treatment conditions:

a) Beetles with only fungus 133,

b) Beetles with only fungus 122,

c) Beetles with both fungi, and

d) Beetles with neither fungus.

Source of variation	df
Tree	2
Bolts in trees	3
Fungus treatment	3
Tree * Fungus treatment	6
Residual	9
Total	23

PRESENTATION OF RESULTS

A final report and a manuscript will be written at the completion of the study. A report of preliminary results of the study is planned for the annual meeting of the Entomological Society of America in December, 1981.

PERSONNEL ASSIGNMENTS

J. Robert Bridges	Research Entomologist
Thelma Perry	Biol. Tech.
Billy Kile	Biol. Tech.
Charles Norris	Temporary Biol. Tech.

DATES OF ESTABLISHMENT AND COMPLETION

The study will start in November 1981 and will be completed in September, 1983.

COOPERATION

The following persons have agreed to cooperate informally in this study by providing SPB when available:

Fred P. Hain, Dept. of Entomology, North Carolina State University

Roy Hedden, School of Forestry, Clemson University

Wayne Berisford, Dept. of Entomology, University of Georgia

Fred Stephen, Dept. of Entomology, University of Arkansas

REFERENCES

Barras, S. J. 1973. Reduction of progeny and development in the southern pine beetle following removal of symbiotic fungi. Can. Entomol. 195: 1295-9.

Barras, S. J. and T. Perry. 1972. Fungal symbionts in the prothoracic mycangium of Dendroctonus frontalis (Coleopt.:Scolytidae). Z. angew. Entomol. 71:95-104.

Barras, S. J. and J. J. Taylor. 1973. Varietal Ceratocystis minor identified from mycangium of Dendroctonus frontalis. Mycopath. Mycol. Appl. 50:293-305.

Thatcher, R. C. and L. S. Pickard. 1964. Seasonal variations in activity of the southern pine beetle in east Texas. J. Econ. Entomol. 57: 840-2.

SO-4000-5 (REV. 9/75)

BIOMETRICS REVIEW ROUTING

ROUTING

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RESEARCH WORK UNIT

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FS-SO-2203-1.46 (STUDY NUMBER)

A SURVEY OF THE MYCANGIAL FUNGI IN ENDEMIC AND EPIDEMIC SOUTHERN PINE BEETLE POPULATIONS (TITLE)

Robert Bridges (AUTHOR SIGNATURE) 9/10/81 (DATE)

REMARKS:

SUBMITTED: Peter L. Lorio, Jr. (PROJECT LEADER SIGNATURE) 9/10/81 (DATE)

AD

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Stanley J. Barras (ASSISTANT DIRECTOR SIGNATURE) 9/14/81 (DATE)

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W D Kepper (BIOMETRICIAN SIGNATURE) 10/5/81 (DATE)

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SO-4C00-5 (REV. 9/75)

BIOMETRICS REVIEW ROUTING

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COPY 1 – ASSISTANT DIRECTOR'S FILE

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ROUTING

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(AUTHOR SIGNATURE) (DATE)

REMARKS:

SUBMITTED: _____ (PROJECT LEADER SIGNATURE) (DATE)

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